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Assessing the Status of Declining Rusty Blackbirds on DoD Lands in Alaska

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Assessing the Status of Declining Rusty Blackbirds on DoD Lands in Alaska

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Executive Summary

Range-wide declines among Rusty Blackbirds (*Euphagus carolinus*) have been documented for 15 years and are now tantamount to an 87–98% reduction in population size. However, it has not been until recent years that studies have sought to quantify the species' resource requirements or research the reasons for its alarming decline. In 2007 and 2008, we examined the ecology of Rusty Blackbirds breeding on military lands in Alaska. Our work clearly highlights the importance of military lands in providing unfragmented wetlands that supported an abundance of breeding Rusty Blackbirds with relatively high reproductive success, low exposures to environmental contaminants, and low prevalence of diseases. Despite these signs of population health, the species continues to decline at a rate of 5–12% per year across its range, including a 5% decline per year in Alaska.

In 2009, we continued our surveys and nest monitoring and began a mark-recapture study to help understand whether the species' continued decline is due to deficits in the rate of reproduction, adult survival, or recruitment of young birds into the breeding population. Such information is important to identify the life stages and times of year when Rusty Blackbird populations are most limited. We found that the number of Rusty Blackbird pairs nesting on military lands in Alaska in 2009 declined 24–33% from the numbers we observed in 2007 and 2008. This decline appears to be the results of too few birds being recruited into the breeding population because annual adult survival increased from 34% in 2008 to 70% in 2009. The low recruitment rate does not appear to be due to a low reproduction rate because nest success remained constant and relatively high from 2007–2009 (62% of nests fledged young). Thus, the deficit in recruitment is most likely the result of a lower survival rate of young compared to older birds. However, more data is needed to understand whether low recruitment is a chronic problem for Rusty Blackbird populations breeding on military lands in Alaska.

We also harnessed 17 nesting Rusty Blackbirds with global locating sensing devices (geolocators) in 2009. Geolocators are a data logging tag (1.3 g) that records the location of birds each day. These devices are a new technology that is already revolutionizing what we know about avian migration. Once retrieved in 2010, the geolocators we deployed will provide us with the first year-around picture of the migrations, stopover locations, and wintering areas of Rusty Blackbirds.

Finally, our study on Rusty Blackbirds breeding on military lands in Alaska has contributed to the five papers accepted for publication as part of a special feature on the Rusty Blackbird in a forthcoming issue of the ornithological journal, *The Condor*. This includes two papers on the species' breeding habitat requirements and nesting ecology in Alaska and Canada. It also includes the finding of three cross-seasonal studies that we contributed blood and feathers to from 2007–2009. These studies provide important range-wide perspectives into the species by using feather isotopes to identify Mississippi and Atlantic flyways, contaminants analyses to identify high methylmercury levels among Rusty Blackbirds in their eastern breeding range, and disease screening to show that wintering populations have an unusually high prevalence of blood parasites, a sign of high stress. Thus our work funded by the Department of Defense's (DoD) Legacy Resources Management Program has contributed greatly to our growing understanding of the range-wide ecology of this migratory species in decline.

Introduction

The Rusty Blackbird (*Euphagus carolinus*) has suffered one of the steepest declines of any bird species in North America and has been extirpated from southern boreal areas where it was once common (Greenberg and Droege 1999, Greenberg 2008, Greenberg et al. *in press*). The International Rusty Blackbird Technical Group—which includes representatives from federal (including DoD), university, and non-governmental agencies in the U.S. and Canada—was formed to increase awareness of the species' plight and implement a strategy to recover populations (Greenberg 2008). The group has emphasized the need to identify demographic limitations, important habitats, and key geographic areas for the species' throughout its annual cycle (Greenberg et al. *in press*). Such information in lacking but would help identify the mechanisms driving the decline, direct conservation towards appropriate life stages and important areas, and ultimately reverse the decline before more costly recovery efforts will be needed.

In 2007 and 2008, the DoD Legacy Program funded our study which assessed the habitat requirements, reproductive success, and factors limiting Rusty Blackbirds breeding on military lands in Alaska. This has been the most comprehensive breeding study on the species and has clearly highlighted the importance of military lands in Alaska to breeding Rusty Blackbirds (Matsuoka et al. 2008, 2009). Unlike other parts of the breeding range, we found Rusty Blackbirds to breed in abundance on Alaskan military lands where they nested in nearly all suitable wetlands ≥7 ha that contained willows (*Salix* spp.) or black spruce (*Picea marina*) for nest sites and shallow fresh water or wet meadows for foraging sites (Matsuoka et al. *in press a*). Rusty Blackbirds benefitted from unfragmented habitats on military lands, particularly in terms of high egg viability (90% eggs hatched), high nest success (64% nests fledged young, Matsuoka et al. *in press b*), and relatively low exposures to diseases and contaminants (Matsuoka et al. 2009). This study has also been a major contributor of feather and blood samples to cross-seasonal studies that have examined methylmercury contamination, the incidence of blood parasite infections, and migratory linkages between breeding and wintering populations of Rusty Blackbirds (Greenberg and Matsuoka *in review*).

Although we found several signs that Rusty Blackbird populations on military lands in Alaska were in good health, the species continues to decline at a rate of 5%–12% per year range-wide (87–99% cumulative decline), including a 5% decline per year in Alaska (Greenberg et al. *in press*). Similar to our study, reproductive success has also been found to be high in New England (Powell et al. *in press*). Thus, factors causing deficits in adult or juvenile survival are likely contributing disproportionately towards the species' decline. For example, chronic mercury exposure may be lowering the physiological condition of birds in eastern breeding range, while losses and alterations of bottomland forests may be degrading the suitability of key wintering habitats (Greenberg et al. *in press*). The population level effects of both these disturbances may manifest on the breeding grounds as reductions in adult survival or recruitment rates (Matsuoka et al. *in press b*). We do not know which of these are linked to the species' decline but such information would help us focus conservation on appropriate age-groups and their associated habitats.

We also have a poor understanding of important areas used by Rusty Blackbirds throughout the non-breeding season, an 8-month long period when the species concentrates in flocks, migrates between boreal and temperate regions, and is exposed to a far greater range of disturbances than on the breeding grounds (Greenberg et al. *in press*). Most of what we know about the species' non-breeding distribution comes from the 3-week long Christmas Bird Count which is conducted before the species has settled on its principal wintering grounds (Greenberg 2008, Hamel and Ozdenerol 2009). Identifying important stopover and wintering areas will clearly help direct conservation to appropriate areas, but distinguishing such areas is difficult using conventional field observation because of the species' large range, long migratory phase, and diminishing flocks which are becoming increasing dispersed and difficult to detect.

In this study, we continue our work on breeding Rusty Blackbirds on Elmendorf Air Force Base, Fort Richardson, and Fort Wainwright, Alaska in cooperation with the International Rusty Blackbird Technical Group. However, we now emphasize the mark-recapture aspects of our study to (1) estimate whether rates of nest survival, adult survival, or recruitment of new birds into the breeding population are limiting population growth on military lands and (2) assess annual movements and identify important non-breeding areas. We approach the latter by capturing adult Rusty Blackbirds at their nests in mist nets and harnessing them with global locating sensing devices (geolocators; Wilson et al. 1992, Burger and Shaffer 2008). Geolocators are small electronic-data loggers that record the timing of sunrise and sunset each day which is then used to estimate latitude and longitude to a 150–200 km resolution. This is a scale appropriate for identifying spring and fall migration routes and general areas used for stopover or wintering. The fitted birds must be recaptured in subsequent years to retrieve the geolocators and download the data; the geolocators neither signal their location nor transmit the stored data via telemetry (Burger and Shaffer 2008).

We also completed the sampling for our assessment of environmental contaminants in Rusty Blackbird breeding on military lands in Alaska. Preliminary findings from 2007 and 2008 indicated that concentrations of mercury and strontium in eggs (n = 12 nests) approached levels of concern; concentrations of all persistent organic environmental contaminants did not (Matsuoka et al. 2009, Chapter 4). We continued to collect unhatched eggs in 2009 and secured $15,000 from the Alaska Department of Fish and Game and the U.S. Fish and Wildlife Service's Environmental Contaminants Programs to analyze contaminants among eggs that we archived from 2007–2008. We used a combination of the Legacy and these other funds to contract the analysis of eggs from 18 nests sampled from 2007–2009. This will increase our overall sample of egg contaminants to 30 nests which will provide robust estimates of egg contamination on military lands in Alaska.

Our work addressing these three primary objectives of our study is not yet complete because we need to (1) mark and recapture additional birds to provide robust estimates of adult survival and recruitment (Matsuoka et al. 2009, Chapter 3), (2) recapture the birds we fitted with geolocators in 2009 in order to download the data on daily movements, and (3) obtain laboratory results on contaminants in the eggs from 18 nests that we submitted for analysis in 2009. We will complete our work addressing these objectives in 2011 and 2012. In addition to these objectives, we contributed the blood and feathers we collected from Rusty Blackbirds breeding on military lands from 2007–2009 to three cross-seasonal and range-wide studies that have recently

published their findings as part of a special feature on this species to be published in a forthcoming issue of the ornithological journal, *The Condor* (Greenberg and Matsuoka *in review*).

In this paper we report our progress in meeting our three primary objectives and discuss the findings from the three cross-seasonal studies that we contributed data to. Specifically we calculated estimates of daily nest survival that included data from 2007–2009 and then discuss these in relationship to our recent analyses of adults survival over the same time period (Matsuoka et al. 2009, Chapter 3). We then summarize our success in fitting Rusty Blackbirds for the first time with geolocators. Finally, we discuss our contributions to three papers in press with *The Condor* that detail the use of feather stable isotopes to determine migratory linkages of breeding and wintering populations of Rusty Blackbirds (Hobson et al. *in press*) and the analysis of blood and feather samples to compare methylmercury levels (Edmonds et al. *in press*) and the prevalence of blood parasites (Barnard et al. *in press*) among breeding and wintering populations.

Methods

The Alaska Bird Observatory led the field sampling on the Tanana Flats Training Area of Fort Wainwright, Alaska (hereinafter Tanana Flats). The U.S. Fish and Wildlife Service and the Alaska Department of Fish and Game led the field sampling on Elmendorf Air Force Base, Fort Richardson, and the Anchorage Coastal Wildlife Refuge, Alaska (hereinafter Anchorage).

We continued our nest monitoring and fully implementing a mark-recapture component to our study of Rusty Blackbirds breeding on military lands in Alaska. We searched for and monitored Rusty Blackbird nests, the latter with iButton temperature loggers, to estimate nest survival in program MARK (White and Burnham 1999). We followed the methods we previously described in detail (Matsuoka et al. 2009, Matsuoka et al. *in press b*). We also captured adults in mist nets placed near their nests, marked each captured bird with a unique combination of one aluminum and three colored-leg bands, and estimated apparent annual adult survival using Cormack-Jolly-Seber model (Lebreton et al. 1992; Matsuoka et al 2009, Chapter 3). We also used a synsacrum harness (Rappole and Tipton 1991) and fitted each captured adult in Anchorage with a geolocator developed by the British Antarctic Survey (1.3 g, 2.3 g with harness). This was the smallest model available and was recently used with success on Wood Thrushes (*Hylocichla mustelina*) which are smaller than Rusty Blackbirds, migrate farther to South America, and inhabit forest understory throughout the year (Stutchbury et al. 2009). We did not harness nestlings or recently fledged juveniles with geolocators because we expected them to be like other young passerines which typically have low rates of survival and natal fidelity.

Finally, we completed our sampling of environmental contaminants and blood parasites in Rusty Blackbird breeding on military lands in Alaska. From each captured adult we collected <70 µl of blood by puncturing the cutaneous ulnar vein in the underwing with a sterile hypodermic needle and then collecting the pooling blood in a microhematocrit tube. One drop of blood was thinly smeared on a glass slide, and immediately fixed in methanol, and latter examined by William Bernard, Norwich University, for blood parasite infections (Barnard et al. *in press*). One drop of blood was archived with the USGS Alaska Science Center for genetic analyses. The remaining

blood was examined by Samuel Edmonds, Acadia University, and David Evers, BioDiversity Research Institute, for methylmercury concentrations (Edmonds et al. *in press*). We collected all unhatched eggs and submitted eggs from 18 nests for analysis of concentrations of metals, organochlorines, and polychlorinated biphenyls. This included both newly collected eggs in 2009 and eggs that we archived in 2007 and 2008.

Results

Abundance and nest survival.—We observed 14 pairs of Rusty Blackbirds nesting on military lands in Anchorage in 2009. This was 33% fewer than we observed in either 2007 or 2008 (*n* = 21 pairs each year, Matsuoka et al. *in press a*). However, we observed an additional 6 pairs nesting off of the military lands at Potter Marsh, a new study we added to the Anchorage study area in order to increase our sample size of marked birds. Similarly, the 24 nest that we found on the Tanana Flats in 2009 was 25% and 23% fewer than we found in 2007 (*n* = 32 nests) or 2008 (*n* = 31 nests), respectively. Thus there appeared to have been a similar reduction in the number of nesting birds in each of the two study areas in 2009.

We found and monitored a total of 50 nests in Anchorage (*n* = 26 nests) and the Tanana Flats combined. We had problems with birds abandoning their nests in Anchorage (*n* = 7 nests) and Tanana Flats (*n* = 3 nests). All abandonments took placed immediately after we either inserted iButtons in nests during the egg laying and early incubation stages (*n* = 7 nests) or captured and harnessed adults with geolocators (*n* = 3 nests in Anchorage). For the former, all instances of abandonment occurred when we first flushed females from their nests prior to fitting the nest with an iButton. Abandonments did not occur when we first waited for females to leave their nests to feed. Of the remaining 40 nests that were not abandoned, one nest in cattails sank into a marsh and failed (2.5%), 10 nests were lost to predators (25.0%), and 29 nests fledged at least one chick (72.5%). In Anchorage, we found females to subsequently renest following five nest abandonments (two females with geolocators), one nest predation event, and the one flooding event (female with a geolocators). As in other years, we found no evidence that females renested after successfully fledging young.

We excluded from our analysis of nest survival the 10 nests that were abandoned following our research activities. We found that a model of daily nest survival with an intercept only was not improved by more than 0.9 AIC_c values when adding any of the six covariates (Table 1). Thus, we did not find substantive evidence that nest survival varied by study area, date, nest age, year (2007–2009), or the quadratic effects of age or date. We used the model with an intercept only and estimated that daily nest survival averaged 0.983 ± 0.002 across years and study areas combined. We exponentiated this daily rate across the 28-day long nesting period and estimated that 62% (95% CI = 53–70%) of the nests fledged at least one nestling.

Mark recapture and deployment of geolocators.—We resighted a total of 19 birds originally banded as adults in 2007–2008 in Anchorage (*n* = 15 birds) and Tanana Flats (*n* = 4 birds). We additionally recaptured three adults in Anchorage that we previously banded as nestlings in the same study areas. We placed bands on a total of 23 previously unmarked adults in Anchorage (*n* = 9 birds) and Tanana Flats (*n* = 14 birds). Our analyses and results on apparent adult survival from 2007–2009 were previously reported by Matsuoka et al. (2009, Chapter 3).

Table 1. Relative fit of models of daily survival rate (DSR) for 139 Rusty Blackbirds nests found on military lands in Anchorage and Tanana Flats, Alaska, 2007–2009. The fit[1] of a model with an intercept only (.) was compared to fit of models with the covariate effects of nest age (age), date, year, study area, and the quadratic effects of nest age (age^2) and date (date^2).

Model	-2loglikelihood	K	AIC$_c$	Δ_i
DSR(date)	336.0	2	340.0	0.0
DSR(age)	336.1	2	340.1	0.1
DSR(.)	338.9	1	340.9	0.9
DSR(date^2)	335.4	3	341.4	1.4
DSR(study area)	337.9	2	341.9	1.8
DSR(age^2)	336.0	3	342.0	2.0
DSR(year)	338.7	3	344.7	4.7

[1] Model fit was compared using -2loglikelihood adjusted for number of parameters in the model (K) and small sample size, which we expressed as Akaike's information criterion (AIC$_c$) and AIC$_c$ differences (Δ_i).

In Anchorage, we successfully fitted 17 adults (n = 12 females and 5 males) with geolocators which weighed 2.3 g with the harness. Ten of the 12 females and all five males fitted with geolocators successfully fledged young (88% of harnessed birds). This included two of the three females that abandoned their clutches immediately after being fit with geolocators. We often observed both males and females fitted with geolocators flying distances greater than 200 m while provisioning both nestlings and fledglings with food.

Discussion

Until quite recently, the best known aspect of the ecology of the Rusty Blackbird was the species' chronic and range-wide population decline of 87–99%. This decline was first reported over a decade ago by Link and Sauer (1996) and soon thereafter detailed for both breeding and wintering populations by Greenberg and Droege (1999). Prior to 2007, no definitive studies had been completed on any other aspect of the species' ecology and the literature on the species' natural history was restricted to brief descriptions in early avifauna accounts that were first summarized by Bent (1958) and later updated by Avery (1995). Our Legacy Program-funded research on Rusty Blackbirds breeding on military lands in Alaska from 2007–2009 has become the most comprehensive study on this species and has provided considerable insight into the Rusty Blackbird's habitat requirements and nesting ecology (Matsuoka et al. in *press a*, *b*) and the importance of military lands in Alaska in providing productive breeding habitats (Matsuoka et al. 2008, 2009). Our study has also been closely coordinated with the research efforts of International Rusty Blackbird Technical Group (Greenberg et al. 2008) and has provided members of the group with blood and feather samples that have been used in several range-wide studies addressing questions of critical importance (Greenberg and Matsuoka *in review*).

Demography and geolocators.—Despite important signs of population health on military lands in Alaska from 2007–2008 (Matsuoka et al. 2009), we found that Rusty Blackbirds experienced a reduction in numbers in 2009. Numbers of nesting Rusty Blackbirds were stable in 2007 and 2008 in both study areas (Matsuoka et al. 2008, 2009). In 2009, we observed a 24% and 33% decline in the number of Rusty Blackbirds nesting on the Tanana Flats and Anchorage, respectively. Over the same period, we found that nest success remained relatively constant, averaging 62%, and that the rate of apparent adult annual survival increased from the year 2007–

2008 ($\Phi = 0.34 \pm 0.11$) to the year 2008–2009 ($\Phi = 0.70 \pm 0.20$; Matsuoka et al. 2009, Chapter 3). Thus, the decline in the numbers of nesting birds in 2009 appears to be the result of a reduction in the rate that new birds were recruited into the local breeding population in 2009 rather than a reduction in reproductive success or adult survival.

A deficit in recruitment would likely arise from a lowering in the survival rate of young birds compared to adults. There is evidence that Rusty Blackbirds partition habitats by gender and age during autumn migration (P. Sinclair, personal communication) and winter (C. Mettke-Hofmann, personal communication), with the adult birds generally usurping the more favorable sites. Thus, it is plausible that poor weather conditions or low availability of food during the non-breeding season of 2008–2009 may have taken a disproportionate toll on young birds. If this was the case, we might expect recruitment to be particularly low in the year spanning 2009–2010 due to the cold and snowy weather across the species' non-breeding range this past winter. We will be able to estimate recruitment rates with additional data in 2010 and 2011 (Matsuoka et al. 2009, Chapter 3). This will help us understand more definitely whether continuing declines in Rusty Blackbirds are the result of deficits in recruitment, adult survival, or reproductive output. Our mark-recapture data from the breeding grounds are particularly valuable in this regards because survival of Rusty Blackbirds cannot be estimated efficiently on the wintering grounds due to the extremely low recapture and resighting rate of birds that were banded during previous years (C. Mettke-Hofmann, personal communication).

We were successful in fitting 17 adult Rusty Blackbirds with geolocators in 2009. We observed few adverse effects of the harnesses among these birds. Almost 90% of harnessed birds successfully fledged young; these birds were routinely observed flying distances greater than 200 m while they provisioned their young with food. Three females did abandon their nests immediately following their capture and harnessing. However, two of these females renested and successfully fledged young. Our data on adult survival from 2007–2009 (Matsuoka et al. 2009, Chapter 3) indicate that we should expect to recapture nine of these birds which will allow us to download the data on their daily movements for an entire year. Geolocators are a relatively new technology that is already revolutionizing what we know about the migrations of birds too small for satellite transmitters (Stutchbury et al. 2009). We eagerly await our opportunity to retrieve these data in 2010, fit an additional 20 birds with geolocators in 2010, and report our findings in future reports to the DoD Legacy Program.

We recommend that researchers do not flush females from their nests during the egg laying and early incubation stages. We sometimes flushed females from their nests during this time in 2009 to fit the nests with iButtons. This resulted in females abandoning their nests in seven instances. In subsequent years, we will only approach nests during these early nesting periods after females have left their nest sites to feed.

International efforts to address the species' decline.—The International Rusty Blackbird Technical Group is currently bringing to press a collection of nine papers to be published as a special feature on the Rusty Blackbird in a forthcoming issue of the ornithological journal, *The Condor*. Results from our study on military lands in Alaska are featured in two papers (Matsuoka et al. *in press a* and *b*) that we included as chapters in our previous report to the DoD Legacy Program (Matsuoka et al. 2009, Chapter 1 and 2). The blood and feathers we collected from

Rusty Blackbird in this study were analyzed among three cross-seasonal studies that are also publishing their findings in the special feature. These papers provide considerable new insight into the species' flyway structure as well as new evidence of stressors on both the breeding and wintering grounds (Greenberg and Matsuoka *in review*).

The primary feathers we sampled in Anchorage were analyzed for hydrogen isotopes and used as part of a large analysis that linked breeding and wintering populations throughout the species' range (Hobson et al. *in press*). This study found a migratory divide with the birds nesting in the western boreal forest (including Alaska) wintering throughout the Lower Mississippi Valley. Conversely, the birds breeding in the more restricted eastern boreal forest wintered east of the Appalachians along the Atlantic Coastal Plain. These separate flyways provide an important framework for both testing hypotheses into the causes of the species' decline and developing complementary conservation efforts between appropriate breeding and wintering populations (Hobson et al. *in press*).

The blood and feathers that we collected from Rusty Blackbirds nesting on military lands in Alaska were analyzed for methylmercury (MeHg) and included in a large analysis of MeHg levels in breeding and wintering populations in both the Mississippi and Atlantic flyways (Edmonds et al. *in press*). MeHg exposure is of concern for this species because it nests in acidic boreal bogs (DesGranges and Houde 1989) where it feeds on high trophic aquatic insects (Matsuoka et al. *in press a*). These wetlands are highly susceptible to atmospheric fallout of industrial pollution which increases both the elemental mercury load and the pH of wetlands. The heightened pH increases the activity of the anaerobic bacteria that methylate mercury (both naturally occurring and from pollution) into its toxic form, MeHg, which then biomagnifies up aquatic food chains. Edmonds et al. (*in press*) found that MeHg levels in Rusty Blackbirds breeding in New England and the Maritime Provinces were 3-times greater than the levels found in adults nesting in Anchorage and the Tanana Flats and 13-times greater than levels in birds wintering in the Lower Mississippi Valley and the Atlantic Coastal Plain. The MeHg levels in New England and Maritime Provinces were among the highest found in a wild passerine population and comparable to levels causing embryo mortalities in other birds. The species is rapidly disappearing in the eastern range (Powell et al. 2008; Greenberg et al. *in press*; Maritime Breeding Bird Atlas, unpublished data)— we urgently need to understand and minimize the effects of these MeHg exposures on the survival, reproductive success, and population trends of birds breeding in the eastern boreal (Edmonds et al. *in press*, Matsuoka et al. *in press b*)

Finally, we collected blood from Rusty Blackbirds as part of a study examining the incidence of blood parasites among breeding and wintering populations of the species (Barnard et al. *in press*). This study found an unexpectedly high prevalence (49%) of blood parasite infections among Rusty Blackbirds wintering in Mississippi which was comparable to the prevalence found among adults breeding in Anchorage, Alaska (44%). This was a surprise because winter is a time when the prevalence of blood parasites among birds is typically quite low due to (1) an absence of the stresses of breeding which causes the blood parasite to migrate from the organs into the peripheral circulatory system and (2) a lack of mosquitoes and biting flies to transmit the parasites to new avian hosts. The high prevalence among birds in Mississippi indicates that wintering Rusty Blackbirds are subject to high levels of stress that are causing an atypical relapse of the parasite into the peripheral circulatory system (Barnard et al. *in press*). Losses and

degradation of wintering habitats are thought to be a leading cause for the species' long-term decline (Greenberg and Droege 1999, Hamel et al. 2009). Research is now needed to understand whether habitat degradation, food limitation, or other factors are resulting in high stress, poor physiological conditions, or a high prevalence of other more virulent infectious diseases among wintering Rusty Blackbirds.

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